BANISTERIA

A JOURNAL DEVOTED TO THE NATURAL HISTORY OF VIRGINIA

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B A N I S T E R I A

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Cover: *Magnolia virginiana* Linnaeus. Original drawing by John Banister, sent to Bishop D. H. Compton in 1689; figure 90 in folio in Sir Hans Sloane's MS 4002 in the British Museum. This and other Banister drawings were provided by Joseph and Nesta Ewan.

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John Banister, Virginia's First Naturalist

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The journal *Banisteria* is named for a naturalist whose Virginia collections have been known to many botanists only through the citations in Linnaeus' *Species plantarum* as *Ray, hist.*, *Pluk. alm.* or *phyt.*, or *Moris. hist.* The Reverend John Banister (1650-1692) was Virginia's first university-trained naturalist. At the age of seventeen he had shown abilities and interests which earned him a scholarship as a chorister at Magdalen College, Oxford University. Although he was in training as a minister in the Anglican Church, he soon discovered nearby Oxford Physick Garden with its plants from much of the known world, and took particular interest in those from America. He attended Professor Robert Morison's lectures given in the Garden, and prepared specimens for an herbarium and a catalog. Professor Morison was busily engaged on his *Plantarum historiae universalis Oxoniensis*, a compendium of native and introduced plants. Having been impressed with Banister's interest and abilities, Morison influenced the Bishop of Oxford, Henry Compton, to send Banister as a minister to the James River area, but with his own interests in mind.

On shipboard after commenting on the *Sargassum* and boobies, which Banister called "gannetts," Banister landed in 1677 in Barbados and again at St. George, Granada. Sometime before Christmas 1677, the sailing ship *Hopewell* arrived in Jamestown, Virginia, with Banister hoping to meet the Governor. Because the Governor had returned to England, and the Deputy-Governor had been killed, Banister proceeded upriver to the Falls, where he met William Byrd I, a young man of his own age. Byrd had come to Virginia, where in 1671 he inherited from his uncle several thousand acres of land, a few slaves, and a thriving trade with the Indians, particularly in rum, guns, hardware, and woolen yardage. Byrd was a practical businessman, interested in whatever natural products might be developed and traded with the mother country. Tobacco was at first the only export permitted by the Crown, but after 1682 trade in other commodities was developed. Iron production was one of Byrd's hopes, and after his purchase of Westover in 1688, he enthusiastically ordered plants from England. Byrd also acted as agent for Virginians for imports. He became particularly important to Banister for arranging for the import of drawing materials, paper, gum arabic, and books. Ordering from such a distance had its disadvantages. As an example, on 8 August 1690 Byrd wrote to a London dealer, "I wonder you doe not So much as mention mr Banister's mony, though he gave me an Order for all in your hands (Which I know you recd) so that is imposible for mee to reckon with mr Banister." On 25 October he wrote again: "pray lett mee know what money you have recd & given credit for, on Mr Banisters account that hee & I may be able to Reckon."

In his letter written from "The Falls Apr. 6. 1679 To my much Esteemed Friend Dr. Robert Morison, Worthy Sir," Banister refers to a letter written perhaps in Barbados, but which we have not been able to locate. He tells of conflicts with "barbarous Enemies the Natives, not our Neighbors but some from the Northward . . . plundering & destroying all as well Indian as English Dutch or French that lye in their way, & are unprovided for them." After some detail of the conflict Banister turned to an account of the natural history. "This is a Country excellently well water'd & so fertile that it does or might be made to yield anything that might conduce to the pleasure or necessity of life. But want of Peace, too much land & ye great croppes of Tobacco men strive to make[,] hinders Virginia from improving. Sir Will Berkeley [who was governor of Virginia 1642-1677] & others in his time endeavor'd something at the Silk Trade: but that of Flaxe I believe if once introduc'd would in a small time turn to very good account." He then went on to give an account of the plants and animals, and an account of Indian sweating. He ends his long letter with "This is all I have yet Observed. You may perhaps find one better able, you cannot I am sure find one more willing to Serve you and his Country than Sir Your Obliged Humble Servant John Banister."

Banister's friendship with Byrd made possible his accompanying Byrd's party on longer expeditions up to, and a little into, the mountains. His first Virginia shipment of plant and insect specimens was sent to Morison in 1680, with plant specimens (some living, or as seeds)

to Compton, now Bishop of London, in his spare time developing his garden of exotics at Lambeth Palace. Among the one hundred fifty plant specimens was the "Sidesaddle flower," the Pitcher plant "of a shape so strange and monstrous that I am afraid," wrote Banister, "that they may be thought to be chamaeras to be found no where but in his brain that drew them. . . . But considering that dryed plants tho illustrated in the work to explain the description can but lead the Limonio [i.e., *Sarracenia*] or diligence into many errors . . . I betook myself therefore to drawing which how well I have or with a little more practice I may perform I must leave you and others to be judge of." Banister's drawing of *Sarracenia purpurea* L. is lost, but Linnaeus cites Plukenet, who published Banister's modified drawing as Pl. CCCLXXVI fig. 6.

From 1682 drawings were sent to Leonard Plukenet, who published them in his *Phytographia* (1691-1705), and plant catalogues to John Ray. Specimens and drawings of insects, spiders, and molluscs were sent to Martin Lister in 1680. In a letter to Bishop Compton in 1689, Banister recognized and described the function of balancers of flies. Robert Hooke in 1665 had also noticed the tiny outgrowths, but had not recognized their function. Banister described a living snail, and left dorsal and ventral drawings of "Cancer Moluccanus, or King Crabb," today known as *Limulus polyphemus* (Linn.). His writings are rich reading.

In 1683 Morison was accidently killed as he crossed an Oxford street. Sometime later Jacob Bobart the younger, Gardener to the Physick Garden, was persuaded to continue Morison's *Historia universalis*. He was fortunate in having the aid of highly trained William Sherard, who later also assisted Ray with his *Historia plantarum*. In London the Temple Bar Coffee House Botany Club hosted a number of folk interested in natural history and Banister's activities in Virginia. Such were Plukenet, Lister, Doody, Compton, George London, Tancred Robinson, and Adam Buddle. Banister had found himself handicapped by the financial uncertainties of the times. Virginians for the most part found the support of ministers by large tobacco donations burdensome, and support of science by the crown was at a low ebb. A flood in 1685 carried away much of Byrd's and neighbors' tobacco. As Plukenet wrote to Byrd, "patron" to Banister, "that which is the great alloy to our alacrity and a cleared damper upon the serenity of our Enjoyment will be the Consideration of our Empty hand offerings to the Encouragement of that worthy and Reverend Gentleman." In order to continue with his natural history, sometime in 1690 Banister acquired 1735 acres of land in Charles City County, and two Africans. That same year a committee met to plan for the establishment of the College of William and Mary. Commissary Blair and Banister were among "the gentlemen that ye said School and Colledge bee founded in ye name of." Due to the difficulties of raising funds for the college, both in Virginia and in the Motherland, the college did not receive its charter until after Banister's death.

His last letter was dated 12 May 1692. With a party he accompanied Byrd on the old Occaneechee trading trail to the Roanoke River in early May. He was probably mistaken for an animal as he stooped to examine a plant, and was shot by one of the woodsmen of the party. Banister left a young son and a wife of two years. His natural history collections were gathered together, and after copies were made of his catalogues, were shipped to Bishop Compton. His library of natural history books was sequestered by Byrd, who hoped with others that a successor would come to Virginia to carry on the work begun by Banister.

Since there was no successor, the books added to the fame of the Byrd library. Linnaeus in composing his *Species plantarum* (1753) cites Banister's plant specimens as he came across references to them in the works of Morison, Plukenet, Ray, and Petiver. Robert Beverley, working in the statehouse after the move from Jamestown to Williamsburg, was fascinated with Banister's "Account of the Natives," and so in his *History and Present State of Virginia* (1705) he published Banister's account verbatim, or but slightly altered. Banister had also been moved by the new animals he found. Of the beaver he wrote: "the Indians call Perecue, ye Overseer of ye Gange whose care it is to see his hands mind their work." The opossum is "a sort of creature with a false belly, into which it receives its young when in danger."

One of the richest descriptions lies among his manuscripts. It concerns Phyllitis (*Camptosorus rhizophyllus* (L.) Link), the Walking Fern: "In our March about 35 miles above the Falls of the James River, on the South side, our small path brought us to a vast Rock, or rather the side of a hill which seem'd to be of one entire stone part of which was very thinly overspread with a swift fall of water, which made a pleasant not loud noise, haveing noe Cragginess to interrupt it's course. A little lower downe this Rivulet is receiv'd into a naturall Bason & from thence conveyed into a small Vault of Craggie Rocks, where with it's fall it makes a dead hollow sound, something like that of a Kettle-drum, but more like an Indian one, which is a skin stretch'd over an earthen pot halfe full of water. It just shews it selfe, and is againe received into an open Arch of rough stone, where among other Capillaryes grows this small but rare kind of Harts

tounge. This Plant grows erect as others of the like kind, till Nature calls it downe to propogate; and when it's offsetts are strong enough to draw in their owne Aliment it leaves them & grows up as before" (Ewan and Ewan, 1970: 229-230). When Linnaeus included the fern in his *Species plantarum* (1753), he cited both Plukenet and Morison with their internal reference to Banister. Petiver in his *Memoirs* (December, 1707) called this "Virginia Hartstongue with proliferous Leaves." Linnaeus also commemorated Banister by giving the name *Banisteria* to a tropical genus of Malpighiaceae, although he had no dried specimen in his herbarium of Banister's West Indies collection. André Michaux commemorated Banister in two genera, *Quercus* and *Woodwardia*, and de Candolle as a memorial named a Brazilian species *Mikania banisteriae*.

John Banister, as John Ray wrote, was "a most erudite man and an accomplished botanist." We honor Banister for the scope of his natural history interests, and the perceptive careful observations he left us.

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Purse-web spiders (Atypidae) in Virginia (Araneida: Mygalomorphae)

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Even professional naturalists are often surprised to learn that the group of spiders commonly called "tarantulas" is represented in Virginia by a number of species in three families. At least one species is statewide and locally abundant, although like the others it is rarely seen because of secretive habits. The recent utilization of static, quantitative collecting techniques has greatly amplified our previously rudimentary knowledge of Virginia mygalomorphs, and provides a useful baseline insight into these interesting arachnids.

Spiders of the small Holarctic family Atypidae are commonly referred to as "purse-web spiders" because their capture webs have the form of cylindrical silken tubes lying along the ground and/or extended vertically on a tree trunk (the latter being typical of the Nearctic species). They are not sticky, and the spider, waiting inside, depends on its speed and alertness to get to the place where an insect is slowed or delayed in crossing. The spider's chelicerae are distinctly elongated to facilitate an upward or outward stab through the web into the victim, which is then dragged inside to be consumed at leisure. The torn entryway is later repaired.

Knowledge of American atypids was synthesized recently by Gertsch & Platnick (1980), who accounted for eight species (four of them described as new). One species, known only from Philadelphia, was referred to the otherwise exclusively Palearctic genus *Atypus*, the other seven placed in *Sphodros*, a taxon endemic in southern and eastern United States. Except for *S. abbotti* in northern Florida and *S. niger* in the northern tier of states, these species were known only from widely scattered localities, one or a few per state. Only three species, *S. rufipes*, *S. atlanticus*, and *S. niger*, were known from Virginia, each from only a single locality.

It is now possible to provide a number of additional records for the last two species named, and to add a fourth *Sphodros* to the fauna of Virginia (as well as vastly augmenting the known range of that species). The ready availability of the excellent synopsis by Gertsch & Platnick obviates the need for diagnoses and illustrations at this time. All four species are basically piceous or black; males of *S. rufipes* are easy to recognize because their legs are mostly a vivid carmine red, but males of the other three (and females of all four) must be distinguished by technical characters. The genus itself can be identified at sight by means of the long, porrect chelicerae, the basal segment of which is half or more as long as the cephalothorax. The cheliceral fang, on the ventral

side, is correspondingly long and slender.

Distributional Data

Sphodros rufipes (Latreille). The red-legged purse-web spider, formerly known by the name *Atypus bicolor* Lucas, occurs chiefly in the Coastal Plain from Rhode Island to Texas, and north to southern Illinois (with a few disjunct localities in the southern Appalachians). It was found at Falls Church, Fairfax County, many decades ago by Nathan Banks, and no subsequent material has come to my attention. More recent finds in Virginia are very desirable.

Sphodros niger (Hentz). This species is the most northern of the genus, with records scattered from Massachusetts and southern Ontario to Minnesota and Kansas, south through the Appalachians almost to Georgia. Gertsch & Platnick (1980: 35) saw but one Virginia specimen, a male found by me 3 miles south of Vesuvius, Rockbridge Co., on 24 June 1956 (AMNH). It is now possible to provide four additional localities: **Augusta Co.:** on forest service road near Spring Pond, 3 miles SW of Sherando, one male found by Kurt A. Buhlmann and me on 26 May 1987 (VMNH); ca. 5 miles west of Stokesville, George Washington National Forest, 14 males from pitfall traps cleared on 17 June 1989, Barry Flamm (VMNH). **Pittsylvania Co.**: pitfall site along South Branch of Sandy River, ca. 3 miles east-northeast of Axton, one male taken during trapping period 15 June–15 July 1992 (VMNH). **Prince Edward Co.**: Hampden-Sydney College, two immature females found in web at base of pine tree on college campus by William A. Shear on 29 November 1989 (VMNH). The cephalothorax, sternum, and legs of these juvenile spiders are testaceous light brown.

Existing records for *S. niger* suggest that, in going southward through Virginia, its range becomes confined to the mountains and western Piedmont. The two North Carolina localities cited by Gertsch & Platnick (1988) are in the Blue Ridge province.

Sphodros atlanticus Gertsch & Platnick. Unrecognized prior to 1980, this spider is among the least-known members of its genus, with single records for Virginia, southern Illinois, and northern Georgia, and two for North Carolina. The Virginia specimen was taken at Fredericksburg, 30 May 1917 (AMNH).

It is now possible to record *S. atlanticus* from several localities in eastern and south-central Virginia, where it is apparently common in its preferred biotopes. **City of Virginia Beach**: Little Creek Amphibious Base, three males from pitfall cleared 22 June 1989, Virginia Division of Natural Heritage survey (VMNH). **City of Chesapeake**: Fentress Naval Air Station, one male from pitfall cleared 6 June 1989, VDNH survey (VMNH). **Isle of Wight Co.:** pine barren study site 4 miles south of Zuni, one male from pitfall cleared 24 May 1985, C. A. Pague (VMNH). **Greensville Co.:** 3 miles southwest of Skippers along Cattail Creek, three males from pitfall cleared 30 May 1990, J. C. Mitchell (VMNH). **Mecklenburg Co.:** 4 miles southeast of Boydton, one male from pitfall along Va. Rte. 692, cleared 16 June 1990, J. C. Mitchell (VMNH). **King George Co.:** Naval Weapons Laboratory, Dahlgren, one male from pitfall in wet mixed forest, cleared 26 June 1991, VDNH survey, via Kurt Buhlmann (VMNH). **Pittsylvania Co.:** floodplain of South Prong Sandy River, ca. 4 miles northeast of Axton, one male from pitfall site in rich, loamy tulip poplar woods, cleared 15 June 1992, VMNH survey (VMNH).

It is noteworthy that from March to November, 1991, the Virginia Museum of Natural History operated a pitfall array in a thin woods of black locust about 3 miles southeast of Mitchell's Mecklenburg County site, without obtaining a single *Sphodros*. Apparently *S. atlanticus* must be fairly stenotopic as well as somewhat restricted in its period of male surface activity. The capture of this species in western Pittsylvania County implies a generally extensive distribution across much of the Piedmont, east of a line connecting Martinsville and Fairfax. The tarsi and metatarsi of the most recently preserved specimen are distinctly red in color rather than orange, confirming the supposition made by Gertsch & Platnick (1980: 29).

Sphodros coylei Gertsch & Platnick. Heretofore, *S. coylei* has been the rarest of American mygalomorph spiders, known only from the original two type specimens found at Clemson, South Carolina, in April 1977. It was therefore a pleasant surprise to discover the species among pitfall samples taken at several sites in eastern and south-central Virginia. **City of Virginia Beach**: Seashore State Park, 37 males taken from pitfalls on 1 March, 14 April, 1 May 1989, 1 male from pitfalls on 9 April and 22 May 1990, all VDNH survey (VMNH). **Isle of Wight Co.:** pine barren 4 mi south of Zuni, one male from pitfall, 24 May 1985, C. A. Pague (VMNH). **York Co.:** Cheatham Annex Naval Supply Depot, east of Williamsburg, three males from pitfall on 16 April 1990, VDNH survey (VMNH 2, AMNH 1). **King George Co.**: Naval Weapons Laboratory, Dahlgren, one male from pitfall in wet mixed woods, cleared 26 June 1991, VDNH survey via Kurt Buhlmann (VMNH). **Pittsylvania Co.:** Lacy Farm, ca. 4 miles ENE of Axton along South Prong Sandy River, 4 males from pitfall 23 April 1992 (VMNH).

Within Seashore State Park, *S. coylei* has been taken in pitfalls placed in habitats characterized as "dune,"

"scrub," and "mesic woods." The site near Zuni is in a dry sandy region in pine woods, that in York County in fairly moist woods. At the Lacy Farm site, this species occurred in a low moist sandy floodplain with tulip poplar canopy. *Sphodros coylei* apparently is not particularly fastidious in habitat preferences.

These new localities not only establish the species as a member of the Virginia spider fauna, but extend its known range some 650 km northeast of the type locality. There can be no doubt that *S. coylei* occurs over much of North Carolina and northern Georgia as well. The Dahlgren site establishes it at the Potomac River, raising an interesting question: is this estuary the definitive northern limit of the species' range, or will future sampling reveal its presence in southern Maryland?

Seasonal activity of males

As with many other kinds of fossorial spiders, females of *Sphodros* tend to be essentially sedentary and are rarely taken in pitfall traps. During the mating season, males wander widely in search of females and are therefore far more likely to be trapped.

This season of male surface activity is fairly characteristic with respect to three of the Virginia species (information is unavailable for *S. rufipes*). Available collection dates and captures are in Table 1.

It is interesting to note that males of *S. niger* and *S. atlanticus*, which are apparently allopatric, are active at about the same time, basically about four weeks from late May to late June. On the other hand, males of *S. atlanticus* and *S. coylei*, which are sympatric if not syntopic, largely are allochronous. *Sphodros coylei* is active from late March to late June, but the major pulse of movements (as indicated by the largest samples) occurred during mid-April in both 1989 and 1990. Captures on the other dates listed are ones and twos. The species are quite different in size: males of *S. atlanticus* averaging about 50% larger than those of *S. coylei*.

The three species discussed above have been found to co-occupy only a single site, that in western Pittsylvania County, where a very clear-cut temporal displacement is evident: *S. coylei* was taken during the time interval 29 March-23 April; *S. atlanticus* from 13 May to 15 June; *S. niger* between 15 June and 14 July.

Acknowledgments

The material on which these records are based is in the Virginia Museum of Natural History (VMNH), except for a few samples in the American Museum of Natural History, New York (AMNH). I am very much indebted to J. C. Mitchell and W. A. Shear for spiders collected by them, and to C. A. Pague and K. A. Buhlmann for extensive series taken through inventory activities of the Virginia Division of Natural Heritage (VDNH) and research conducted by Barry Flamm and Robert Glasgow, George Washington National Forest, Harrisonburg.

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Table 1. Male seasonal surface activity of purse-web spiders in Virginia. Dates are the last day of two-week or one-month sampling periods.

Species	March			April				May						June				July
niger										25	26				16	17		14
atlanticus									24		27	30	6	15	16		22	26
coylei	29	31	9	14	16	23	1	22	23	24	26							

Banisteria, 1, 1992

Movement of the Dogbane Beetle, *Chrysochus auratus* (Coleoptera: Chrysomelidae), in a Patchy Environment

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The dogbane beetle, *Chrysochus auratus* (Fabricius), is an herbivorous beetle widely distributed in the eastern and midwestern United States (Wilcox, 1975). *Chrysochus auratus* feeds almost exclusively on plants of the genus *Apocynum*, particularly *A. cannabinum* L. (Indian hemp) and *A. androsaemifolium* L. (spreading dogbane) (Weiss and West, 1921; Dussourd and Eisner, 1987; Williams, 1988b, 1991). Adults are foliovores, feeding chiefly on *Apocynum* leaves; larvae are fossorial and feed on *Apocynum* roots (Felt, 1901; Weiss and West, 1921).

The population ecology of *C. auratus* has been little studied. Cursory observations suggest that adults often occur in small, sporadically distributed populations even when host plants are abundant (Williams, 1988b), similar to the distribution of the red milkweed beetle, *Tetraopes tetraophthalmus* (Forster) (Coleoptera: Cerambycidae) (McCauley et al., 1981; McCauley, 1989), among patches of *Asclepias*. Limited dispersal of adults is a major factor affecting the distribution of *T. tetraophthalmus* among host plant patches (McCauley et al., 1981; McCauley, 1989). As the life histories of *C. auratus* and *T. tetraophthalmus* are strikingly similar (see Lawrence, 1988, for a review of the life history of *T. tetraophthalmus*), might limited dispersal abilities of *C. auratus* adults explain in part the sporadic distribution of this species among patches of *Apocynum*?

In this note, I describe the movement patterns of a small population of *C. auratus* adults within and among patches of *Apocynum* in the Ridge and Valley Province of southwestern Virginia. Specific attention is given to: 1) the frequency of intra- and interpatch movements; and 2) the length of time adults remain in *Apocynum* patches (patch tenure time). Patch tenure time was of interest as extended residency in host plant patches may enable some specialist insect herbivores to more fully exploit unpredictable host plant resources (e.g., Bach, 1982; Williams, 1988a).

This study was conducted from June to August 1989 in a small old field bordering a commercial Christmas tree plantation in Blacksburg, Montgomery County, Virginia. Observations of *C. auratus* adults were centered primarily on three patches of *A. cannabinum* known to be inhabited by beetles in previous years. Patch 1 consisted of 19 stems ($\bar{x}$ height = 80.5±3.8 cm, mean±SE), patch 2 of 12 stems ($\bar{x}$ height = 71.1±3.6 cm) and patch 3 of 44 stems ($\bar{x}$ height = 50.7±3.0 cm). The *Apocynum* patches were in a linear array with patches separated by ca. 20 m. Additionally, three host plant patches located >200 m from the primary *Apocynum* patches were monitored to determine if long-distance exchanges of beetles might occur (two patches were dominated by *A. androsaemifolium* [9 and 15 stems], one patch by *A. cannabinum* [27 stems]). No other *Apocynum* patches occurred in the conifer plantation or old field.

All *Apocynum* stems in the patches were tagged with numbered plastic bird bands (National Tag and Band Co., Newport, Kentucky) during early June. *Apocynum* patches were searched daily between 1300 and 1500 hr for *C. auratus* adults beginning in mid-June and until beetles were no longer found (early August). When discovered, individual beetles were each marked with a unique pattern of enamel paint on elytra (preliminary observations indicated that marking did not affect beetle movement), and placed at the base of stems from which they were captured. Location of marked beetles was recorded for each sampling day, and the daily distance moved by beetles within the primary *Apocynum* patches was determined by measuring the straight-line distance between recaptures (Smith and Grodowitz, 1987). Since beetle sample sizes were small, no attempt was made to determine differences in dispersal between the sexes.

The total number of *C. auratus* adults observed in the

six *Apocynum* patches was low. Seventeen beetles were captured during the study: 15 beetles within the three primary *Apocynum* patches and 2 beetles in two of the three distant patches. Of the 15 *C. auratus* adults marked in the primary patches, 10 (67%) were recaptured more than once. Beetles were observed most frequently in *Apocynum* patch 1 followed by patches 2 and 3 (Fig. 1). The majority of beetles captured in the primary patches were first encountered in *Apocynum* patch 1 (12 beetles).

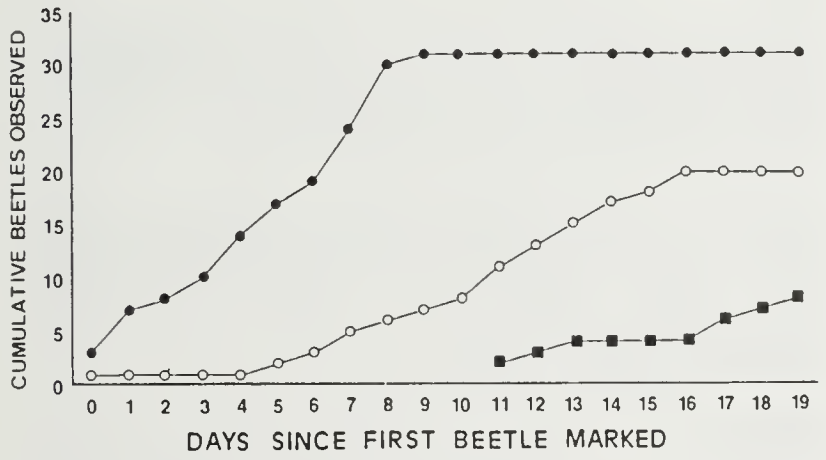

Figure 1. Cumulative observations of *Chrysochus auratus* adults in the three primary *Apocynum* patches, July to August 1989. Closed circles = patch 1, open circles = patch 2, closed blocks = patch 3.

Short-distance movements of 5 m or less were most frequently observed for marked *C. auratus* adults, comprising 82.2% of recorded movements (Fig. 2). Short-distance movements typically consisted of within patch, plant to plant movements. Movements of 12 m or greater (17.8%) were primarily dispersal flights in which beetles either colonized adjacent *Apocynum* patches or left the study area. Interpatch movements, however, were recorded infrequently; only five beetles were recaptured in *Apocynum* patches other than those in which they were first encountered. No interpatch exchanges occurred between beetles marked in the three primary *Apocynum* patches and those marked in distant patches. Patch tenure time for beetles in the three primary *Apocynum* patches averaged 3.2±0.7 days (range = 1-9).

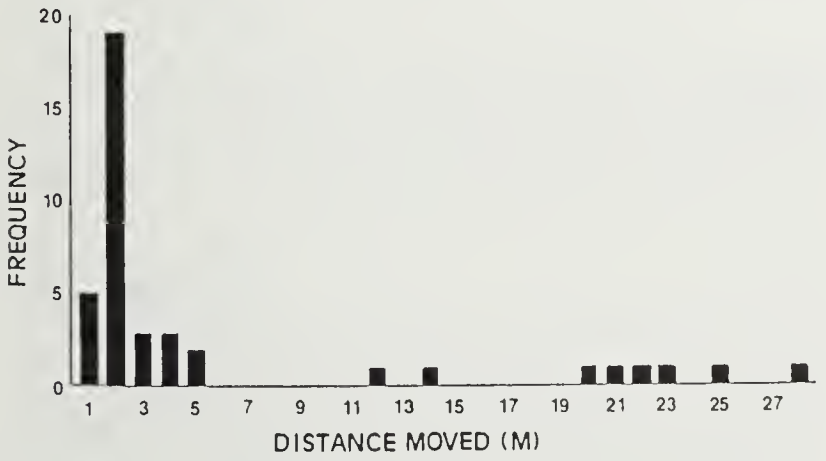

Figure 2. Frequency distribution of movements for recaptured individuals of *Chrysochus auratus* in the three primary *Apocynum* patches, July to August 1989.

Population size, patch tenure time, and the distribution of movements that I recorded for *C. auratus* are comparable to observations of *T. tetraophthalmus* reported in several studies (McCauley et al., 1981; Lawrence, 1988; McCauley, 1989). Among small host plant patches, both insects exhibit a preponderance of short-distance, plant to plant movements, relatively low patch tenure times (some specialist herbivorous insects remain in patches for several weeks; see Bach, 1982; Williams, 1988a), and small population sizes. My results, although limited, do not directly demonstrate that *C. auratus* adults are poor dispersers (e.g., it is unknown how far adults moved once they left the study area) or that limited dispersal influences the distribution of the species among *Apocynum* patches. Instead, the low frequency of interpatch movements recorded during this study suggests that *C. auratus* may be a relatively poor colonizer of patchy host plant resources.

Numerous factors may influence the probability that a host plant patch is colonized by herbivorous insects, including the number of host plants in a patch, and the chemical and physical distinctness of the host plant patch from the surrounding vegetational matrix (patch apparency) (Root, 1973). These factors are also primary correlates of herbivore population size (e.g., Cromartie, 1975; Lawrence, 1988). Unfortunately, given the small number of beetles encountered during this study, no association of *Apocynum* patch attributes with either *C. auratus* population size or colonizer success could be made.

Low success in host location may only partially explain the sporadic distribution of *C. auratus* among *Apocynum* patches. The size and persistence of *C. auratus* populations may also depend on the availability of larval food resources. Patches of *Apocynum* with considerable root biomass, such as older well established patches, should support larger populations of *C. auratus* larvae and ultimately produce more adults. Well established *Apocynum* patches could be sources of dispersing beetles that may then colonize adjacent patches (for example, contrast the number of beetles first encountered in *Apocynum* patch 1, an apparent source patch, with the other patches). Thus, availability of larval food resources, in conjunction with the host location abilities of adults, may determine the distribution and abundance of *C. auratus* among *Apocynum* patches.

Acknowledgments

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Observations on the Mammals of Mackay Island National Wildlife Refuge, Virginia and North Carolina

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Mackay Island National Wildlife Refuge lies at the southern end of Back Bay in the City of Virginia Beach, Virginia and at the northern end of Currituck Sound in Currituck County, North Carolina. Knotts Island, on which the refuge is located, is separated from the mainland by marshes and bays and from Currituck Spit by Knotts Island Channel. The marshes in the Virginia portion have been described by Priest and Dewing (1991). Other aspects of the physical environment, flora, and fauna of the area have been described in Marshall and Norman (1991).

I conducted a tentative study of the mammalian fauna of Mackay Island National Wildlife Refuge during the winter and early spring of 1963 and 1964. Most of the information presented here was derived from observations of mammals and their signs, riding the causeway and other roads at night, and specimens caught in small live mammal traps and snap traps set a various times during the course of the study. These observations establish a first checklist of the mammals of this area and provide historical data against which later information can be compared. The taxonomy in the checklist follows Webster et al. (1985).

Annotated Checklist

Order Marsupialia
Family Didelphidae

Didelphis virginiana (Virginia opossum) - Common. Preferred habitats include woods and thickets, although this species can be found throughout the refuge.

Order Insectivora
Family Soricidae

Blarina carolinensis (Southern short-tailed shrew) - The most common insectivore on the refuge. Five specimens were collected as follows: 2 March 1963, male, 100 mm total length (TOTL), 19 mm tail length (TL); 15 March 1963, female, 93 mm TOTL, 17 mm TL, associated nest under board contained 4 neonates with umbilical cords; 20 March 1963, female, 99 mm TOTL, 20 mm TL; 22 March 1963, male, 100 mm TOTL, 17 mm TL; 29 March 1963, 94 mm TOTL, 19 mm TL, contained five well-developed embryos. This species was found in fallow fields, pine stands growing in sphagnum bogs, and in cattail and phragmites marshes. Several skulls of this species were found in barn owl pellets.

Family Talpidae

Scalopus aquaticus (Eastern mole) - Burrows of this species were observed in lawns, cultivated fields, meadows, and thin forest.

Order Rodentia
Family Sciuridae

Sciurus carolinensis (Gray squirrel) - Restricted to the wooded sections of the refuge.

Family Cricetidae

Peromyscus gossypinus (Cotton mouse) - One specimen found dead on the road (DOR) near a pine woods section at the northeastern end of the refuge.

Oryzomys palustris (Marsh rice rat) - Common. Several specimens were caught in live traps and released. The following specimens were collected: female, 232 mm TOTL, 116 mm TL; male, 253 mm TOTL, 123 mm TL; male, 234 mm TOTL, 119 mm TL; unsexed, 235 mm TOTL, 115 mm TL; unsexed, 232 mm TOTL, 120 mm TL.

Microtus pennsylvanicus (Meadow vole) - Common in brackish and freshwater marshes. Numerous specimens were found under boards at the watch tower and several freshly killed specimens were seen near barn owl's nests. One specimen found on the causeway (male, 180 mm TOTL, 48 mm TL) may have been captured and killed by a raccoon. On 18 March 1964 a nest of this species was found under a board near the watch tower containing four young approximately five days old. An adult female left the nest upon lifting the board. The young averaged 50 mm TOTL and 9 mm TL.

Ondatra zibethicus (Muskrat) - Generally abundant throughout the refuge. There was an apparent a decline

in the number of muskrats seen during 1962–1964.

Family Muridae

Mus musculus (House mouse) - Common in areas around buildings, marshes, and cultivated fields.

Rattus norvegicus (Norway rat) - Commonly found in the marshes.

Family Myocastoridae

Myocastor coypus (Nutria) - This species inclined during 1962-1964 and was abundant throughout the marshes on the refuge.

Order Lagomorpha
Family Leporidae

Sylvilagus floridanus (Eastern cottontail) - Common on the refuge in farmlands, brushlands, woods, and gardens, but entirely absent from the marshes.

Sylvilagus palustris (Marsh rabbit) - Abundant in all the marshy habitats on the refuge. Seldom found together with the eastern cottontail.

Order Carnivora
Family Canidae

Urocyon cinereoargenteus (Gray fox) - Fairly abundant throughout the refuge in all habitats. Tracks of this species were found around carcasses of ducks, geese, and swans that were killed in the winters of 1962 and 1963.

Family Felidae

Felis rufus (Bobcat) - Several sets of tracks believed to be of this species were seen on 4 May 1964 in a ditch along Mackay Island road.

Family Procyonidae

Procyon lotor (Raccoon) - Common throughout the refuge in all habitats. As many as 15 or more were seen at night on the causeway. In the winters of 1962 and 1963 a number of dead geese, ducks, and swans were found partially eaten; all had raccoon tracks leading to the carcasses. One raccoon had apparently killed and eaten a meadow vole.

Family Mustelidae

Lutra canadensis (River otter) - Isolated pairs occur throughout the refuge. Tracks, slides, and other signs were frequently observed. On 4 May 1964 I found the carcasses of two snakes, northern black racer (*Coluber constrictor*) and rainbow snake (*Farancia erytrogramma*), that had been killed and partially eaten by an otter or otters. In the case of the rainbow snake, a hole had been torn in the venter and only the viscera had been eaten.

Mustela frenata (Long-tailed weasel) - Two DOR specimens (male and female) were collected.

Mustela vison (Mink) - Generally common over most of the refuge. It was commonly observed around the watch tower in the winter and early spring of 1963. Following the spring of 1964 the watch tower burned and minks were not observed in this area afterwards.

Discussion

The two most abundant mammals on Mackay Island I encountered in the early 1960s were rice rats and meadow voles. They apparently served as an important prey base for local avian and mammalian predators, such as mink, raccoon, gray fox, barn owl, marsh hawk, and others. These two prey species comprised the majority of the remains in the 1000+ barn owl pellets I examined from three nests. These pellets also contained an occasional skull of the southern short-tailed shrew and a few birds, mostly red-winged blackbirds.

The apparent decline of the muskrat population in the early 1960s is puzzling. The nutria population increased in size during this time, leading to the supposition that there is a negative spatial relationship between these species. Other reasons, such as an internal parasitic or disease epidemic, cannot be ruled out, however.

The range of prey consumed by two of the predators on Mackay Island, gray fox and raccoon, indicate their roles as generalists in this ecosystem. Both scavenge for dead prey, such as the migratory waterfowl killed during winter freezes, and live prey, such as the meadow vole apparently killed by the raccoon. Otters are uncommon predators of snakes, at least as far as known. The observations reported above represent the first known accounts of otter predation on these two snakes in Virginia (J.C. Mitchell, pers. comm.).

The marsh rabbit is now listed as a species of special concern by the Commonwealth of Virginia (Handley, 1991). It was commonly found in marsh habitat in the early 1960s, however, its status on Mackay Island National Wildlife Refuge today is unknown. Two other species of conservation concern, bobcat (status undetermined) and river otter (special concern) (Handley, 1991), were apparently common in the early 1960s. It is noteworthy to point out that the Pungo mouse (*Peromyscus leucopus easti*), a subspecies considered by the Virginia Division of Natural Heritage to be globally rare due to its small range (Pague and Buhlmann, 1991), was not observed or collected during my study.

The list of mammals of Mackay Island National

Wildlife Refuge reported above is based on the first known observations of these animals in this area. The tentative list is presented here so that it may stimulate a more complete inventory in the future and serve as a baseline against which changes in species composition may be judged.

A number of species not encountered in my survey may yet be found on Mackay Island because their ranges encompass this area and because the habitats in which they are known to occur are also found there. These include southeastern shrew (*Sorex longirostris*), least shrew (*Cryptotis parva*), star-nosed mole (*Condylura cristata*), eastern harvest mouse (*Reithrodontomys humulis*), white-footed mouse (*Peromyscus leucopus*), golden mouse (*Ochrotomys nuttalli*), woodland vole (*Microtus pinetorum*), and meadow jumping mouse (*Zapus hudsonius*).

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[Editor's note: The Norfolk Museum of Natural History, initiated about 1952, ceased to exist in the early 1970s, and was taken over by the Chrysler Museum of Art. The natural history specimens collected by de Rageot were stored in a warehouse; the mammals were subsequently lost or destroyed.]

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Invertebrate Prey of *Bufo woodhousii fowleri* (Anura: Bufonidae) from a Virginia Barrier Island

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The Virginia barrier islands harbor a diverse flora and fauna considerably different from those on the mainland (Klotz, 1986; Conant et al., 1990). The island's flora and vertebrates have been the primary subjects of research and inventory (e.g., Clovis, 1968; Dueser and Brown, 1980; Hill, 1986; Scott, 1986; Cranford and Maly, 1990; McCaffrey and Dueser, 1990a), while the terrestrial invertebrate fauna has received little attention.

Toads of the genus *Bufo* are well known prey generalists, consuming a wide range of invertebrate taxa. Most of the summaries of prey taken by *Bufo woodhousii fowleri* (Fowler's toad) refer simply to broad

taxonomic categories, generally to order or family level (e.g., Brown, 1974), or simply insects and other invertebrates (Barbour, 1971; Mount, 1975; Green and Pauley, 1987). Few papers report generic-level identifications (Bush and Menhenick, 1962), and none provide species-level information except for one observation of an amphipod as prey of this species on Smith Island (Conant et al., 1990). Prey diversity of this anuran on either the Virginia mainland or the barrier islands has not been reported.

Among the stomach content files in the U.S. Fish and Wildlife Service facility at Patuxent, Maryland (archives of the former U.S. Biological Survey) is a series of cards containing information on the prey of *B. w. fowleri* from Smith Island, Virginia. The 13 toads (in the collection of the U.S. National Museum of Natural History, USNM) were collected on 16 May 1894 (USNM 22637-22645) by C. W. Richmond and on 10-20 May 1910 (USNM 40228, 40235, 40238, 40246) by E. A. Mearns. The stomach contents of these specimens were subsequently examined by Remington Kellogg and C. W. Leister, and the prey identified to the species level where possible. Note that because the invertebrate identifications were not made by professional entomologists, the taxonomic names should be confirmed with additional research.

Smith Island lies in the southeastern portion of Northampton County, Virginia, and is the second from last large, southern island in the string of barrier islands fringing the Atlantic Ocean margin of the Delmarva peninsula. It is approximately 512 hectares in size, lies 4.7 km off the mainland, and harbors a diverse flora and assortment of plant associations (Dueser and Brown, 1980; McCaffrey and Dueser, 1990a, 1990b).

Table 1 contains the first list of invertebrate taxa for the Virginia barrier islands and the first list of prey for *B. w. fowleri* from the Commonwealth. The thirteen toads consumed a wide variety of prey species consisting mostly of terrestrial beetles and ants. Beetle taxa vastly outnumbered other taxa but hymenopterans (ants) dominated in number of individual prey. The toads that contained the largest numbers of ants (*Aphaenogaster fulva, Crematogaster lineolata, Lasius niger*) probably consumed them at colony sites. The dominance of these two insect orders in the Smith Island sample of Fowler's toads is concordant with the results in Bush and Menhinick (1962). Dipterans and hemipterans were scarcely represented. Although lepidopteran larvae and spiders were not identified to family or species, they were consumed by several individual toads and represented a substantial number of individuals. The majority of the listed taxa are mainly or strictly terrestrial invertebrates and their representation here supports Brown's (1974) observations in Arkansas that *B. w. fowleri* are essentially limited to ground-dwelling prey.

Bush and Menhinick (1962) listed the insect genera they found in the stomachs of Fowler's toads collected around Athens, Georgia. The following genera were found in both the samples reported by Bush and Menhinick (1962) and in this paper: Coleoptera - *Amara, Aphodius, Ataenius, Clivina, Scarites, Selenophorus, Tyloderma;* Hymenoptera - *Crematogaster.* All are apparently habitat generalists, as they occur in urban and insular environments.

As prey generalists, toads should eat anything of appropriate size that they encounter in the terrestrial environment. If the prey consumed by the thirteen toads represent a random sample of invertebrates on Smith Island, then the above-listed ants and beetles of the genus *Anisodactylus* are the most commonly encountered species. The terrestrial insect diversity appears to be high, as the remaining taxa were encountered in low but similar numbers. Additional inventories of insects and other invertebrates should be undertaken on Smith Island and other Virginia barrier islands to confirm the presence of the taxa reported here, and to provide a baseline database on these animals against which future changes in the habitats can be assessed.

Acknowledgments

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Table 1. List of invertebrate prey in samples of thirteen *Bufo woodhousii fowleri* from Smith Island, Virginia. The first column in the table refers to the number of specimens with the particular prey taxon and the second is the number of prey items (total = 245).

Coleoptera		
Agonoderus infuscatus (Dejean)	1	1
Agonoderus lineola (Fabr.)	3	7
Agonoderus sp.	1	3
Amara sp.	1	1
Anomala undulata Melsheimer	2	5
Anisodactylus sp.	3	13
Aphodius sp.	2	2
Ataenius sp.	2	4
Ataenius cognatus Le Conte	1	1
Bembidium sp.	1	1
Brachinus sp.	2	2
Calleida viridipennis Say	1	1
Carabidae (unid.)	4	4
Cerambycidae (unid.)	1	4
Clivina sp.	1	3
Dyschirius sp.	2	6
Elateridae (unid.)	2	1
Geotrupes sp.	1	1
Hyperodes sp.	1	1
Lampyridae (unid.)	1	1
Lasioderma serricorne (Fabr.)	1	1
Ludius sp.	1	1
Melanotus (*fissilis* Say ?)	3	5
Monocrepidius bellus Say	1	1
Nacerda melanura (Linnaeus)	2	5
Platyderma sp.	1	1
Rhyssemus scaber Haldeman	2	1
Scarites subterraneus Fabr.	3	4
Selenophorus sp.	1	1
Staphylinidae (unid.)	1	1
Stenolophus sp.	3	3
Tenebrionidae (unid.)	2	2
Tyloderma aerea Say	1	1
Diptera		
Hylemyia sp.	1	1
Limonius sp.	1	1
Hemiptera		
Blissus leucopterus Say	1	1
Cryphula trimaculata (Distant)	1	2
Hymenoptera		
Aphaenogaster fulva Roger	1	23
Crematogaster lineolata Say	2	31
Lasius niger (Linnaeus)	4	48
Lasius sp.	1	6
Myrmica rubra	2	3
Prenolchis sp.	1	1
Sphecodes sp.	1	1
Tapinoma sessile (Say)	1	4
Tetramorium caespitum (Linneaus)	1	4
Orthoptera		
Acrididae (unid.)	1	1
Gryllotalpa hexadactyla (Perty)	1	1
Crustacea		
Gammarus sp.	1	9
Porcellio sp.	1	2
Miscellaneous Taxa		
Lepidoptera larvae	5	9
Spiders (unid.)	8	10

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Cardamine micranthera Rollins, Small-anthered Bittercress in Patrick County: New to the Virginia Flora

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In 1940 a new species of mustard was described by Reed C. Rollins of the Gray Herbarium from Stokes County, North Carolina, having been discovered by Dovovan S. Correll and G.W. McDowell the previous year (Rollins, 1940). The species was subsequently found in Forsyth County, North Carolina, by Albert E. Radford but these two counties of North Carolina were, for many years, the only known occurrences of this plant. The first publication on North Carolina's endangered and threatened plants (Hardin et al., 1977) treated the species as presumably extinct. Subsequently, persistent efforts to rediscover the plant along Peter's Creek in Stokes County were made by Steven W. Leonard (Leonard, 1986) who succeeded in finding a population in 1985. Soon thereafter, small-anthered bittercress became a candidate for listing as a federal endangered species (becoming officially listed on 21 September 1989, Murdock, 1989), encouraging additional efforts to find more plants in this section of the Dan River drainage. Searches by Leonard and others included visits to sections of Peter's Creek in Patrick County, Virginia, just across the state line from Stokes County, but were without success. These searches were confounded by the presence in Virginia of *Cardamine rotundifolia*, a similar plant which occupies similar habitats. In the spring of 1990, Richard Hoffman, Ali Wieboldt, and I joined Alan Weakley of the North Carolina Heritage Program in searching for *Cardamine micranthera* in Virginia. We found the plant almost immediately upon stepping off the bank into the waters of Peter's Creek as we headed for a small tributary entering on the opposite side. Several primary tributaries were visited during the day, in each case revealing additional populations. Interestingly, small-anthered bittercress was found growing near *Cardamine rotundifolia*, round-leaved bittercress. As the name indicates, *Cardamine micranthera* has very small anthers and might be mistaken for *Cardamine rotundifolia* were it not for additional differences, namely its upright habit and leaves with longer stalks and more leaflets.

How far into Patrick County does *Cardamine micranthera* extend? Does it occur in other drainages? Working our way east, we next found the species on Russell Creek, in the South Mayo River drainage. Searches to the west of Peter's Creek were unsuccessful. The full range of *Cardamine micranthera* in Virginia is yet to be determined.

The systematics of *Cardamine micranthera* and *C. rotundifolia* begs to be studied. Their morphologies indicate a close relationship. Small anthers (reduction in pollen output) are often associated with the evolution of inbreeding (Gibbs et al., 1975). If apogamy is the means by which *Cardamine micranthera* arose, sufficient time has elapsed to allow additional morphological variation such as the habit and foliar features previously mentioned. In Virginia, *Cardamine rotundifolia* is not infrequent in the more mountainous portion of Patrick County to the north. Yet, only a few miles to the south in North Carolina, it is known only historically. As the streams draining from the Blue Ridge escarpment traverse the hill country outlying the mountains, they cut their way down to the level of the Dan River creating small areas of montane microclimate. Did *Cardamine micranthera* originate from montane *C. rotundifolia* isolated sometime in the past in these outlying hills? The presence of additional populations of *Cardamine micranthera* in Virginia affords the opportunity to investigate these ideas and study the dynamics involved in the evolution of endemism in Virginia's native flora.

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Notes on the Swampfish (*Chologaster cornuta* Agassiz) in the Dismal Swamp of Virginia

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The swampfish (*Chologaster cornuta*) is a member of the family of cave fishes, Amblyopsidae. It occupies one end of a continuum of species showing adaptations to cave life, such as eye degeneration and pigment reduction. The swampfish is the epigean representative of the group and has functional eyes, although the optic tectum and optic lobes are reduced (Poulson, 1963); it has a dark pigmentary pattern. It is a small fish (23-57 mm standard length) that occupies cryptic habitats in swamps, ponds, ditches, and slow-moving streams of the Atlantic Coastal Plain (Cooper and Rohde, 1980). Water temperatures in habitats with this nocturnal fish never exceed 23 C (Poulson, 1963). Southeastern Virginia is the northern range limit of the swampfish. Here this species is known from the Chowan drainage, a tributary of the Chickahominy system (James drainage), the Dismal Swamp, and from a pond in Seashore State Park in Virginia Beach (Jenkins and Burkhead, in press).

Between 20 September 1953 and 4 December 1954 I collected a total of 13 *C. cornuta*. All were found in a single pool in the Virginia portion of the Dismal Swamp. They were collected with a dipnet used to sweep the bottom of the pool. The fish were recovered by carefully searching among dead leaves and other debris. In this note I report observations on its habitat, body size, reproduction, habitat associates, and the extirpation of one population.

The habitat in which the specimens were collected was a small, stagnant pool 150 m from Jericho Ditch near Lake Drummond. The area surrounding the pool was covered with abundant, large deciduous trees which kept the pool shaded during summer. During periods of heavy rain in the fall and winter, water was transferred from a large ditch to the pool via a rivulet. As a result, the water level of the pool varied from approximately 0.8 m in heavy rains to 0.5 m during normal weather, and 0.3-0.5 m during dry weather. The pool was never completely dry during the study period, even during a prolonged drought.

The specimens were collected as follows: 20 September 1953, adult, 23.5 mm total length (TL), water level 5 cm; 4 December 1953, 4 adults, water level 5 cm; 6 March 1954, 2 adult females, water level 0.6 m; 5 June 1954, 2 juveniles, 17 and 20 mm TL, water level 8 cm; 4 December 1954, 4 adults, water level 0.6 m. One of the females taken on 6 March was 40.5 mm TL and contained 131 undeveloped eggs and 63 mature, yolked ova measuring 1.5-2.0 mm in diameter. The number of mature ova is smaller than the average number of eggs (98) reported by Poulson (1961, in Cooper and Rohde, 1980) from a sample of 13 specimens taken from throughout the range of this species. The sizes of mature ova reported by Poulson (0.9-1.2 mm, 1963) are smaller than those from the single fish reported here. Ova size suggest spawning probably occurred in March or early-April in the Dismal Swamp, comparable to the period reported in Cooper and Rohde (1980).

Habitat associates in the Dismal Swamp included the

vertebrates many-lined salamander (*Stereochilus marginatus*) and mudminnow (*Umbra pygmaea*), and unidentified species of isopods, ostracods, copepods, and cladocerans. The invertebrates are known prey of *Chologaster* (Cooper and Rohde, 1980).

During late April 1955 an electric transmission line was installed through the area and all the timber was removed to make this operation possible. The pool became exposed to sunlight and subsequently remained completely dry for a great portion of the summer and fall. No *Chologaster* have been found since the alteration of the habitat. Increased water temperature and pool drying undoubtedly led to the local extirpation of *Chologaster* at this site. Before removal of the timber, the pool containing the swampfish was the only one in the area that never completely dried. Numerous additional collecting trips in 1955 yielded no swampfish at this or other locations in the Virginia portion of the Dismal Swamp. These observations suggest that *Chologaster cornuta* populations were declining in this area during the 1950s.

Acknowledgments

Robert E. Jenkins provided comments on an early draft of this paper. The final draft was written from de Rageot's unpublished ms by Joseph C. Mitchell.

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Banisteria, Number 1, 1992

Bothynotus johnstoni Knight in Virginia (Heteroptera: Miridae)

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Many species of the large family Miridae are specifically phytophagous, and such bugs are fairly easy to obtain by collecting on host plants. Others, frequently very rare in collections, appear to be ground dwellers and are taken by trapping techniques. The species under consideration at this time belongs in this category, and is moreover of particular interest owing to its striking sexual dimorphism: the females having convex and rather sclerotized hemelytra imparting the aspect of small beetles.

The genus *Bothynotus* was revised just over a decade ago (Henry, 1979), at which time existing knowledge about the several Nearctic species was reviewed. *B. johnstoni*, the second known Nearctic species, was named by Harry H. Knight in 1933 from a male collected at Carthage, Mississippi, and remained known only from that locality until appearance of Henry's paper, when material was recorded from central Florida (Highlands and Lake counties) and northern Georgia (Clarke and Union counties). Henry was able to match up the bizarre coleopteroid females with syntopic males, and provided an excellent drawing of a female from Georgia.

In sorting through the extensive pitfall samples made at three localities in Seashore State Park, City of Virginia Beach, by the Virginia Division of Natural Heritage in 1989 and 1990, technicians at the Virginia Museum of Natural History recovered a single female collected on 8 February 1990 from the drift fence sample established in a forested wetland site. It agrees in every respect with Henry's illustration (reproduced here as Fig. 1) and detailed description, and leaves no doubt about the identification. This discovery extends the known range of *B. johnstoni* some 700 km (420 miles) northeast of the Georgia localities and adds yet another element to the

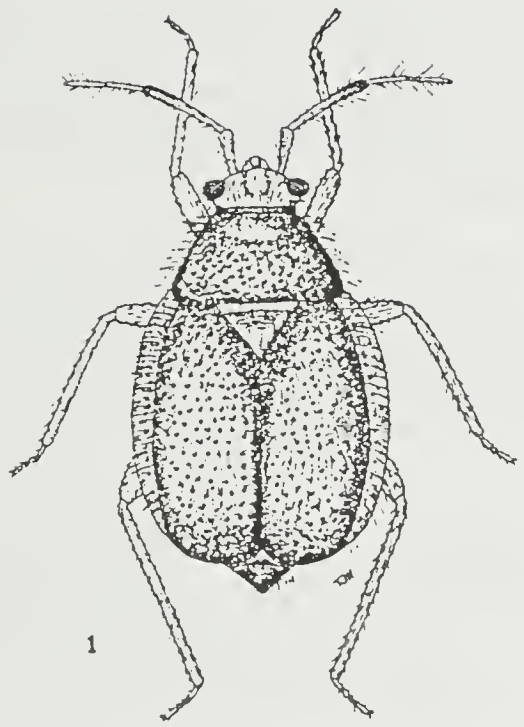

Fig. 1. *Bothynotus johnstoni* Knight, female (from Henry, 1979).

dominantly austral biota of Seashore State Park and to the heteropterous fauna of Virginia as well.

Males of this species have been taken chiefly at lights, females (probably not volant) mostly from pitfall traps. Those from Clarke County, Georgia, were from pitfalls set in sandy soil about 6 m from the Oconee River, in mixed oak-hickory woods. It is remarkable that the drift fence pitfalls in Seashore State Park, which were operated continuously for 15 months in sandy habitats, obtained but a single specimen. However, with over a hundred samples from various other sites in Virginia beach yet to be sorted, it seems possible that others may be recovered.

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Henry, T. J. 1979. Review of the New World species of *Bothynotus* Fieber (Hemiptera: Miridae). Florida Entomologist 62:232-244.

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Acanthocephala declivis (Say), a Coreid Bug New to the Virginia Fauna

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Four species of the coreid genus *Acanthocephala* occur in southeastern United States. One was recorded for Virginia in my synopsis of the squash bugs of the state (1975) and two others were listed as likely to occur. For one of the latter, *A. declivis* (Say), I noted that the northernmost known locality was Raleigh, North Carolina (Brimley, 1938), and prophesied that "It seems entirely probable that *declivis* will be discovered in south-central Virginia."

In recently transferring the Heteroptera from the insect collection donated by the University of Richmond to this Museum I was delighted to notice a strikingly big *Acanthocephala* which proved to be *A. declivis* and therefore fulfilled the prophesy. The insect was collected by W. Russell on 20 July 1938 at Borgart's Beach on the James River, just north of Smithfield, Isle of Wight County. In extending the known range of the species approximately 220 km to the northeast, this record brings the known Virginia coreids to 16 and narrows the gap that existed with North Carolina's 19 species.

Now it becomes the turn of *A. femorata*, likewise known from central and eastern North Carolina, to be discovered in Virginia.

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Virginia's Largest Insect Collection – A Rich Resource for Biodiversity Information

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It is the intent with this publication to provide an assessment of the insect collections housed at Virginia Polytechnic Institute and State University and jointly maintained with the Virginia Museum of Natural History (VMNH) since 1989. We want to make available this information to the user community so that the collection records may be more fully utilized for environmental assessments (Kosztarab, 1987) and biodiversity studies in Virginia.

The collection was started by Professor William B. Alwood in 1888, and as such has become the oldest and largest continuously maintained insect collection in Virginia. A major expansion to ca 50,000 specimens occurred during 1891 to 1925 when Professor Ellison A. Smyth was curator, and also during the past 30 years with a twelvefold increase in size.

An assessment on the collection was printed 25 years ago (Covell and Kosztarab, 1966), at which time it included approximately 81,000 specimens. As the result of a number of major donations, intensive collecting in the state, and several relevant research projects, the collection now numbers approximately 862,800 specimens. The real value of the collection lies not in the number of specimens but in its quality and its unique components, given later in this article. The National Science Foundation recognized the value of the Collection for the nation with a grant in 1984.

Description of the Collection and Associated Facilities

As shown in Table 1, the insect collections at the Virginia Tech museum include 16 major orders and a few small orders. The geographic coverage for three orders is for the mid-Atlantic states, including Virginia; for nine orders it is for eastern United States; for four orders it is for the Nearctic; and for one sub-order the coverage is worldwide. This collection is unique in the eastern United States because it includes 148,429 slide-mounted specimens, 1,032 types, and 1,613 voucher specimens. Examples of the damage or malformations produced by insects and their life stages are preserved in 540 Riker mounts. In addition, there are 1,450 plant specimens on sheets and in boxes comprising the Herbarium of Insect and Mite Damage.

The insect collection, based on its uniqueness and degree of utilization (loans, exchanges, visitors, publications, etc.), is a major resource for our active research projects, but is also considered a world resource. The productivity in terms of taxonomic publications over the past 30 years is proof that the collections are fully utilized. Our research team published approximately 120 research papers, 30 research bulletins, and four books during this time period, with a total of approximately 4,500 printed pages.

The collection is housed in the new museum building at 428 North Main Street in Blacksburg. The building is about 10,000 sq. ft. with about 2,500 sq. ft. used for housing the insect collections. There are 52 insect cabinets with 1,902 Cornell drawers, 16 metal cabinets with 1,400 vial racks filled with vials, and 640 alcohol-filled jars with shell vials. In addition, in the museum and in Price Hall (Room 301B), we house 148,492 slide-mounted insect specimens in 13 cabinets each with a 3,000 slide capacity. The main part of the general systematic entomology library is kept in the J. M. Grayson Library, Price Hall (Room 305) and includes hundreds of books and thousands of reprints taking approximately 120 linear ft. of shelf space. Specialized library material is kept in the offices and laboratories of faculty members working on the systematics of various taxa.

Unique Parts of the Collection

The collection holdings have been summarized for Coleoptera by Arnett and Samuelson (1969). The more recent acquisitions were reported in the Entomology Department Newsletters (Kosztarab, 1969-1984).

During the past thirty years the collection became a depository for voucher specimens resulting from research

by our faculty and graduate students, and serves as a reference collection for our identification services that often include insects from states other than Virginia. It is used intensively for taxonomic and biosystematic research by graduate students, faculty and visiting scientists.

The collection contains a unique Herbarium of Insect and Mite Damage, probably the first in North America. Established in 1962 (Kosztarab, 1966), it includes herbarium specimens with malformations or other characteristic and species-specific evidence produced by insects. These include leaf mines, leaf and stem distortions, discolorations, galleries of wood-boring insects, plant gall formations, leaf skeletonization, and characteristic webbing, egg masses, and malformations produced with oviposition. This unique collection provides possibilities for insect taxonomists to identify the pest species by the evidence left behind, even after the pest is long gone. Many species of plant gall makers and leafminers are easier to identify by the species-specific malformations that they produce than by the structure of the insects themselves.

The Scale Insect (Coccinea) collection is the third or fourth largest in North America. It is probably exceeded in size only by those of the National Museum of Natural History and the state collections in California and Florida. During the past thirty years it has become an internationally utilized collection for research and for deposition of type specimens of scales. The representation is international, with some special emphasis on North America, Central Europe, and Costa Rica. Types of scale insects make up the largest proportion of the total type collection. The results of our Coccinea studies, primarily based on the collection, have been published in 19 research bulletins, 3 books and in numerous other articles. This part of the collection is computerized and two hard copies of the inventory have been already published (Kosztarab and Rhoades 1985 and 1986).

Our second largest collection includes soil mites and spider mites (Acarina) with about 100,000 specimens, half on slides. We have one of the largest collections in the eastern United States, that includes material from three mite workers: L. R. Cagle, S. L. Poe, and J. A. Weidhaas. More soil mites have been recently included from our study on acid rain effects on soil arthropods.

The Coleoptera collection (with about 50,000 specimens), is one of the largest in the mid-Atlantic states. Pinned specimens are stored in 240 Cornell drawers and the alcohol preserved material fills an entire cabinet. Although we have no specialist for the group, our material was used in the preparation of research bulletins on the aquatic Hydrophilidae, Haliplidae and Dytiscidae. The Carabidae, Cerambycidae, and Cicindelidae are under study at present for the preparation of regional identification manuals.

The Hemiptera collection with about 13,000 specimens is among the more comprehensive in the eastern U. S., and has served as a basis for our research bulletins on the aquatic and semiaquatic Hemiptera, Coreoidea, and Pentatomoidea of Virginia.

The best representation of Lepidoptera (about 40,000 specimens) is in the collections of Geometridae and Noctuidae, which have regional significance. The geometrid genus, *Scopula*, was revised for North America in the Entomology Department in 1965, greatly benefiting our collection.

The biting midge and mosquito (Diptera: Ceratopogonidae and Culicidae) collections, with over 30,000 specimens, are among the largest in the eastern United States, and were used for revisions of the genera *Bezzia* and *Culicoides* of the Nearctic Region and Eastern U. S., respectively. Similarly, our Tabanidae and Calliphoridae collections have a good representation for the Eastern United States and provided the basis for two research bulletins in 1973 and 1977.

The aquatic insects, 38,000 specimens, are the fastest growing part of our collection at present. We have a 700-page manuscript on the dragonflies of Virginia and vicinity. Other manuscripts in preparation are on the damselflies, mayflies, stoneflies, and caddisflies of Virginia and vicinity.

The cockroach collection (Blattodea) is of worldwide coverage and includes about 3,500 preserved specimens and about 350,000 live specimens in rearing, representing about 40 species.

Other taxa that are well represented for the Eastern United States include the Acrididae, Mecoptera, Siphonaptera, and the ticks (Metastigmata). Of the estimated 20,000 species of insects in Virginia (Kosztarab, 1987) only about half are represented in the collection. Therefore, more intensive collecting is needed, especially in the biotic regions still neglected by entomologists.

Its many uses and importance of the Collection for the research, teaching and outreach programs of our University were summarized in an in-house study (Voshell et al., 1981).

Loan Policy

The length of loans is six or twelve months, unless requested for a longer period. Outstanding loans are reviewed each January. Loan requests for aquatic insects are processed by J. Reese Voshell, Jr., while dry-preserved, pinned, and slide-mounted specimens are handled

by Mary Rhoades. We encourage exchanges of duplicates. When a new species is described from our material, we expect at least one paratype to be deposited in our Museum Collection and the holotype to be deposited in the National Museum of Natural History. Loans for graduate research are given to the student's major advisor.

Utilization on an Annual Basis for the Past Five Years

Our collections are available for study to the entire scientific community. Visitors to our insect collections during 1986-1990 included 106 person (10 students) from the U. S., and 22 (4 students) from foreign countries, who spent a total of 688 days in our facilities. Loans in five years included a total of 66 (23 to students) for non-scale insects, and 22 (9 to students) for scales in the U.S., and 13 to foreign countries, with a total of about 10,990 specimens. Exchanges for a five year period included 22 on non-scale insects and 10 on scales, 9 of these to foreign countries, with a total of about 1,905 specimens. Requests for professional assistance in systematics that required the utilization of our insect reference collections included in five years a total of 295 calls. The calls counted here are in addition to the requests received by our Insect Identification Lab. That lab utilized our reference collections to provide determinations and advice (free) for 8,493 requests for help over a five-year period.

Acknowledgments

The donors of insects to the Collection have been acknowledged in the past in Covell and Kosztarab (1966), and in the Newsletters of the Department of Entomology (Kosztarab 1969-1984), therefore are not listed here. Major donations since 1985 included 6,104 specimens from Ellison A. and Mary Linda Smyth; 1,065 from Amie J. Birdwhistell; 1,437 from Noma C. Wilkinson; 22,000 from University of Richmond; and 28,474 from the author's Ohio and tropical America's scale collections.

I express my appreciation to Linda Bland for typing my manuscript and to J. Reese Voshell, Jr., Mary Rhoades, and the two editors of *Banisteria* for their helpful suggestions and editing of my paper.

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Table 1. Numbers of Specimens in the VMNH at VT Insect Collection (1992)

Taxa or Categories	Dry Preserved		Alcohol Preserved		Slide Mounted	Types	Voucher	Other	Geographic Coverage (No. gen/fam revised)
	Pinned	In Envelopes	Adults	Larvae					
A. RESEARCH Collection									
Collembola			12,000	3,000	250				Mid-Atlantic States
Other Apterygota	200		300	150	300				Mid-Atlantic States
*Ephemeroptera	40		2,640	1,200	220	12	25		Eastern US (1 genus)
*Odonata	3,100	6,400	6,640	140		14	168		Eastern US (7 gen)
*Plecoptera	90		3,400	1,100		6	12		Nearctic
Orthoptera	6,747		1,700	110	480				Mid-Atlantic States
Blattodea	1,120		130		2,100	6			World-wide
*Hemiptera	10,400		1,900	230	70		205		Eastern US (22 f, 94 g)
Homoptera (non-scales)	9,400		2,400		180		10		Mid-Atlantic States
*Coccinea	700	274,400	70,120	13,000	71,834	981	724		World-wide (9 fam, 32 gen)
Neuroptera and Megaloptera	640		990	670	21				Nearctic
*Coleoptera	33,325		9,900	1,340	60	5	101		Eastern US (3 f, 37 g)
*Trichoptera	360		10,100	2,300	110	6	90	1,500	Eastern US (1)
*Lepidoptera	22,335	3,982		9,200	60				Eastern US (1 genus)
*Diptera (non-midges)	26,285		2,300	1,700	210		156		Eastern US (3 f, 36 g)
*Ceratopogonidae	2,700		6,800	1,400	19,260		75		Nearctic (2 genera)
Siphonaptera			540	130	918		15		Eastern US
Hymenoptera	16,050		3,600	1,600	70	1	12		Eastern US
*Acari			50,760	5,800	48,700				Nearctic (2 f, 6 gen)
Other Orders	980	62	2,375	845	768	1	20		Nearctic
Total Research Colls.	134,382	284,844	188,595	43,915	145,611	1,032	1,613	1,500	
B. SURVEY-Collection	16,900		7,200	1,580					Virginia
C. TEACHING Collection	18,780		2,800	1,450	2,800				Mid-Atlantic States
D. DISPLAY Cabinets	6,100		350	150					Virginia
E. QUARANTINE Collection	600		40	30					World-wide
F. RIKER Collection								540	Virginia
G. HERBARIUM of Insect and Mite Damage								1,450	Mid-Atlantic States
H. LEAFMINER Collection	180	80	240	25	18				Nearctic
Grand Total	176,942	284,924	199,225	47,150	148,429	1,032	1,613	3,490	All Specimens 862,805

*Used for recent revisions and/or faunistic studies. Number of families or genera revised for publication by our workers is given in parenthesis.

Instructions for Contributors

Banisteria accepts manuscripts of one to several pages in length that contribute to the public and scientific knowledge of the natural history of Virginia. This publication is intended to be an outlet for the kind of information that would otherwise go unpublished. Information found in old field notebooks and files that never made it into scientific journals is especially important. **Banisteria** does not intend to publish theoretical papers, those using molecular techniques, nor descriptions of new taxa. Its focus is more classical and therefore slanted toward organismal biology. Papers should be data-rich and without long-winded interpretations.

Manuscripts should be sent in duplicate to one of the co-editors, who will assign them to an appropriate section editor, who in turn will seek one or two reviews. Reviews of manuscripts written by a section editor will be handled by a different editor. Authors should retain both the original typescript and figures until final acceptance for publication. Photocopies are adequate for review purposes.

The Manuscript

The active voice is preferred. Manuscripts must be written on one side of standard size paper (21.5 x 28 cm) using double spacing throughout. Words should not be divided at the right-hand margin.

Manuscripts should be arranged in the following order: **title, author's name, author's address, text, acknowledgments, literature cited, tables, figure legends, figures**. Manuscripts longer than 4-6 pages should have standard sections, e.g., Materials and Methods, Results, and Discussion. All pages should be numbered, including tables. The title should be concise but informative. It, and the author's name and address should be centered at the top of the first page. The text should begin on the first page beneath the author's address. Use good judgement on arrangement of sections when other than the standard approach is necessary. Use underlines for species' scientific names.

References: Use the following as a guide. Do not abbreviate journal names.

Journal article with 1 author:
Scott, D. 1986. Notes on the eastern hognose snake, *Heterodon platyrhinos* Latreille (Squamata: Colubridae), in a Virginia barrier island. Brimleyana 12:51-55.

Journal with 2 authors:
Tilley, S. C., and D. W. Tinkle. 1968. A reinterpretation of the reproductive cycle and demography of the salamander *Desmognathus ochrophaeus*. Copeia 1968:299-303.

Journal with 3+ authors:
Funderburg, J. B., P. Hertz, and W. M. Kerfoot. 1974. A range extension for the carpenter frog, *Rana virgatipes* Cope, in the Chesapeake Bay region. Bulletin Maryland Herpetological Society 10:77-79.

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Harris, L. D. 1984. The Fragmented Forest. University of Chicago Press, Chicago, Illinois. 211 pp.

Chapter in a book:
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Report:
The Nature Conservancy. 1975. The preservation of natural diversity: A survey and recommendations. Report to the U.S. Dept. of Interior, Washington, D.C., 189 pp. (include report series and number if present).

Tables: Each table should be typed on a separate sheet of paper. A legend for each table should follow the number and must be on the same page as the table. Ruled, horizontal lines should be avoided except at the top and bottom of the table.

Figures: Black and white line drawings are acceptable for publication. They should be less than 21.5 x 28 cm in size. The back of each figure should be labeled with the author's name.

Photographs: **Banisteria** will accept high-contrast black-and-white photographs.

Abbreviations: The following are common abbreviations accepted in **Banisteria**: $\bar{x}$ (mean), n (sample size), no. (number), yr (years), mo (months), wk (weeks), h (hours), min (minutes), s (seconds), P (probability), df (degrees of freedom), SD and SE (standard deviation and standard error), NS (not significant), l (liter), g (grams), mm (millimeter), C (degrees Celsius). Do not abbreviate "male" or "female," or dates, or undefined terms.

Electronic transfer of manuscripts: Once a manuscript has been accepted for publication, one paper copy and an electronic copy on 5.25" or 3.5" diskette should be sent to a co-editor. If possible, use IBM-compatible (MS-DOS) systems with WordPerfect 5.1 or later version.

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Chrysogonum virginianum Linnaeus

Original drawing by John Banister. Figure 83 in folio in Hans Sloane's MS 4002 in the British Museum. Photocopy courtesy of Joseph and Nesta Ewan.